Editor's Comments

Ramping Up to the U.S. National Data Highway[1]

We know nothing of what will happen in the future, but by the analogy of experience.
—Abraham Lincoln

One good shove and the construction of the U.S. national data highway will be in full swing. Local phone companies, cellular providers, cable companies, home shopping networks, long distance providers, and firms from many other industries are merging, forming joint ventures, or otherwise strategically posturing for the journey ahead. One observer compares this state of readiness with an Olympic bicycle race: "All of these guys are on their expensive racing bikes going five miles per hour, waiting for someone to make a break. And then they all go like mad."[2]

The data highway, or the National Information Infrastructure as it is called by its most visible spokesperson, Vice President Al Gore, is really a network of communications networks. Although the data highway will largely be funded by private industry, an analogy is often drawn between it and the interstate highway system, previously championed by Gore's father. This analogy requires some further reflection. Although the interstate highway system has provided the U.S. with many economic benefits, these benefits have been accompanied by some disruptions of society. With foresight, similar social costs might be avoided or ameliorated for the data highway. A brief historical overview of transportation systems in the U.S. provides some insights into how the U.S. and other national data highway initiatives might evolve.

Transportation systems have always been a key organizing factor for business communities and societies. For instance, at the end of the last century, the distance between two breweries was established by how far a horse could draw a beer wagon in a day. The confluence of two rivers or the junction of railroad lines similarly helped to locate industrial centers. A network of service industries—education, entertainment, financial, retail, government—grew up to serve the workers who settled in these centers. With the introduction of the internal combustion engine, people followed developers into ever more distant suburbs. There they remained physically tethered to their work and the city center by automobiles or commuter systems.

The interstate highway system led to further suburban sprawl. Waves of malls, discount stores, and catalog shopping provided suburban dwellers with a rich cornucopia of products. Interstate city ring roads and the development of an interstate trucking industry permitted office-based businesses and light industries to follow workers out of the city. For these firms the suburbs offered clean air, cheaper land, and a well-educated populace. But here, too, were mile after indistinguishable mile of video-stores, car dealerships, and restaurant and fast food chains. And, left behind in the city centers, in the shadows of the interstate highway overpasses, were often a shrinking tax base, a crumbling city infrastructure, and a decimated downtown marketplace. Also, in the city centers were failing public education systems, poorly funded cultural institutions, and an environment seemingly best suited for the nourishment of crime.

Today, advances in cellular, fiber optics, cable, and satellite technology are giving birth to powerful and intelligent networks of two-way, personalized, high bandwidth communications systems. These networks, embellished by new electronic tools for manipulating and presenting information, will increasingly be substituted for transportation systems. Transportation systems, though powerful engines of productivity in the past, retain many very unappealing economic characteristics. They consume scarce fossil fuels, pollute the environment, waste time, serve limited markets, and are unreliable, noisy, dangerous, and physically divisive. They also are subject to labor disruptions, require large tracts of scarce contiguous real estate, and present nearly impossible capacity management challenges given a high, fixed-cost

[1] I am indebted to the other members of the Society for Information Management's National Data Highway Advisory Council who have contributed to a number of the ideas in this essay but bear no responsibility for it.

[2] Steward Personick, an executive of Bellcore, as quoted in "The Race to Rewire," by Andrew Kupfer, *Fortune*, April 19, 1993, p. 60.

capital investment. By comparison, communications systems have relatively low operating costs and will provide instantaneous and nearly invisible access to almost anywhere in the world. Substituting communications for transportation will become an economic necessity for firms and countries that will successfully compete in the economy of the future. This substitution is relatively straightforward, and underway, for knowledge-based work in fields such as advertising, engineering, research, consulting, and even medicine. But the pressures of competition will drive us to tease the knowledge component from the elements of work that still require physical labor, the distribution of energy or materials, or the establishment of personal relationships. In the past people *went* to work, to shop, or to obtain desired services. In the future products and services will *come* to the people. Over time, this will generate further savings and environmental benefits by reducing the need for offices, stores, educational institutions, and the like.

No one knows what an information highway-equipped knowledge-based society will look like, but it is not too early to begin to draw a vision. A future vision for health care, for instance, will have doctors again making house calls through the use of teleconferencing and remote diagnostics. The doctor will be assisted by home patient monitoring systems, as well as electronic linkages to medical science repositories, world-renown specialists, and extensive family and personal medical histories. Expert systems, linked to self-diagnostic systems, will let patients monitor their own condition. Home entertainment centers will provide access to a vast range of movies, music, sporting and cultural events. We will electronically watch our grandchild's school play or football game, or we might create our own multimedia productions for distribution and possible sale to others. A selection of the great art of the world will be available for display on your electronic walls, or, if you prefer, electronic windows will give you and millions of others the opportunity to unobtrusively observe wild animals at a watering hole in Africa.

Education in this new world will be transformed from work into something far more engaging and creativity-inducing. From the safety of their homes or neighborhood education centers, students will visit the core of a live volcano with a noted volcano expert, wander through the human circulatory system, or participate face-to-face in multinational learning experiences. The heretofore geographically fragmented higher education industry will be concentrated as the best schools and a small number of star teachers use distance learning and sophisticated educational software to reach far beyond current markets and into homes, cars, or offices. The one-to-many classroom education that served us for decades will be replaced by interactive and personalized learning systems that extensively track and guide individual student performance. Textbook publishers will be gone, but the market for educational software will be massive, with many professors teaming up with multimedia designers to make vast fortunes.

Despite the great promise of the knowledge age, and of national data highways such as that proposed for the U.S., there are reasons to be cautious. As discussed above, the interstate highway system, while economically advantageous, has been socially disruptive. It is not difficult to envision ways in which this new electronic highway may create its own set of social problems. Individual workers may increasingly choose to work as self-employed business people in this new world. Communications technologies will lower the transaction costs associated with the use of outside suppliers. This will spur corporations to increasingly turn to these flexible resources for non-core competency functions. Some, and perhaps many, of these self-employed knowledge workers will choose to live in comfortable rural or small-town surroundings several hours' drive from the nearest major city. For such workers, employers will no longer provide a social safety net, and collective bargaining arrangements will be unlikely. Unbuffered by a large bureaucracy and working in a highly fluid marketplace, such workers are likely to be frequently and often adversely impacted by changes in the economy. In addition to health care and retirement, they will have to take responsibility for their further education and career development. And they will do so in a world where the half-life of knowledge continues to shrink and where barriers to entry for other self-employed competitors may be little more than technical know-how and an established network of relationships. These newly ruralized workers will no longer contribute taxes in their old city centers. In fact, many will choose to locate in environments that offer attractive tax rates. Services to those who remain in the old city centers will likely further deteriorate. Motivated by their shareholders, private pro-

viders of the data highway's communications services can be expected to seek out affluent communities more likely to guarantee a profitable investment. With no guarantee of equal access, economically disadvantaged communities will fall further behind as their access to this new highway is blocked.

Other issues will need to be confronted as the data highway speeds forward. The data highway is a tool for national competitiveness, yet increasing global business will require that citizens of other countries have access to the highway. Elaborate pricing schemes must be created and administered reflecting the variety of ways that people will be willing to acquire information services. Sophisticated marketing systems will precisely identify potential customers and then, at relatively little expense, fill their electronic in-baskets with unsolicited promotions. Today, only the U.S. postal service can use the home mailbox. Will similar legal constraints be required for your electronic mailbox? The government's role must be clearly defined. New privacy legislation will be necessary, as will advancement in laws related to the protection of intellectual property rights. As the various national highways will intersect, new treaties will be required with foreign governments. Global reach will also create issues around personal freedoms. One observer asks, "Which nation's constitution defines, or denies, your right to put a radical message on an Iranian bulletin board?"[3] In addition to ensuring universal access to the economically disadvantaged, the government will need to oversee and probably help to fund the growth of the data highway into educational and research institutions. Governments also seem likely to spur on initial pilots that will help to build critical mass, as well as funding research in areas such as data compression, optical switching, or establishing linkages among the various networks that make up the highway. And then there is the mundane but important need to sort out the muddle of current regulations.[4]

National security issues must also be considered, as well as a very important set of concerns relating to use of the system to support the democratic process. What is the electronic equivalent to a street demonstration, a letter to the editor, or a sit-in?

The working world that the data highway will engender might be described as "anybody, anytime, anywhere." But being able to work out of a lakeside cabin in Montana sounds a lot more appealing than the reality of having your personal phone summon you to an emergency teleconference while you are fishing on that lake at sunrise. Nor will it always be a delight to respond to a valued customer's latest unexpected request-for-proposal during the three hours you were going to spend with your daughter at a virtual baseball game. Without proper precautions, this electronic world will take away more personal freedom than it gives.

National data highways, as with interstate highway systems, can indeed be powerful economic engines. They have the potential to transform education, improve the quality of our lives, ensure national competitiveness, and bring the world together to work on pressing global problems. But there is a considerable potential for unfair use or unintended negative consequences. These networks can threaten democracy or leave nations with uneducated populations that are poorly equipped to participate in a knowledge-intensive world economy. They can also unravel business strategies that fail to reflect the economic implications of moving from a physical goods and transportation-based society to one based on knowledge, services, and communications. We must first try to envision life in this new age and then begin to appropriately shape public policy, our organization's strategic direction, and our own career paths.

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With this issue Bob Bostrom completes his service on our editorial board. Bob has been a dedicated associate editor who has added considerable value to the works of many authors and prospective authors. He has done so in a timely and sensitive manner. We are most appreciative of Bob's many contributions to *MISQ.*

—Blake Ives

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[3] Wright, R. "The New Democrat from Cyberspace: Mitch Kapor, Data Highway Guru," *The New Republic*, May 24, 1993, p. 27.

[4] On September 15, 1993, the U.S. Government issued a draft report entitled, "The National Information Infrastructure: Agenda for Action," which defines the Clinton administration's current position on many of these issues. The report is available from NTIA, NII Office, 15th Street and Constitution Avenue, Washington, D.C. 20230 (Internet: nii@ntia.doc.gov).